Ecofallow Reduces Stalk Rot in Grain Sorghum

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ABSTRACT

Data obtained in 1972, 1973, and 1974 showed that ecofallow (reduced tillage) decreased the incidence of stalk rot in grain sorghum grown in a winter wheat-grain sorghum-fallow rotation. Stalk rot averaged 39% in the conventionally tilled plots, whereas, the incidence of stalk rot in the minimum- and nontilled plots averaged 23% and 11%, respectively.

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During the past decade Wicks and Smika have been studying the feasibility of reduced tillage in a winter wheat-grain sorghum-fallow rotation for the semiarid Great Plains area (6). They refer to their reduced tillage systems as "ecofallow" systems (Smika and Wicks, *unpublished*). Ecofallow is defined as a system of controlling weeds and conserving soil moisture in a crop rotation with minimum disturbance of crop residue and soil. Weeds are controlled either with sweep tillage and herbicides (minimum tillage) or herbicides alone (no tillage). Ecofallow has decreased wind and water erosion, and energy requirements and increased water storage efficiency during the fallow period, and, most importantly, has increased the grain yields of wheat and sorghum. Wheat yields were increased 6% and 8% and grain sorghum yields 31% and 47% with minimum and no tillage, respectively, above the 10-year average yields obtained with conventional tillage (6).

What effect the ecofallow system has on the incidence of plant diseases is important, since certain plant pathogens can survive and even build up in crop residues left on the soil surface and in weeds and volunteer plants (2, 3) when reduced tillage is practiced. Smika and Wicks did not observe any problems with foliar diseases on either wheat or grain sorghum during the 10 years of this study; however, they consistently observed more grain sorghum plants lodged in the conventionally tilled plots than in the ecofallow plots at harvest time. We began a study in 1972 to determine the long-term effects of ecofallow on stalk rot of grain sorghum using the plots originally set up by Smika and Wicks (6). A preliminary report has been published (4).

MATERIALS AND METHODS.—*Experimental site history.*—Soil at the experimental site located south of North Platte, NE, is 61 m deep and is classified as a Holdrege silt loam, which was developed on Peorian loess. The slope of the experimental site is less than 0.5%. Average annual precipitation for North Platte is 49.3 cm. All treatments were initially applied to the experimental area in 1962 and have been maintained since that time. Before 1962, the area had been continuously cropped to grain sorghum for two years.

Treatments and experimental design.—Stalk rot data were obtained from three tillage practices in a winter wheat-grain sorghum-fallow rotation [*Triticum aestivum* L. 'Lancer' and *Sorghum bicolor* (L.) Moench. 'RS 626']. The tillage treatments compared were one conventional and two ecofallow (reduced tillage) systems. These systems are described in Table 1 (footnotes b, c, and d) and correspond to those previously described by Smika and Wicks (6) as A_3 (conventional tillage), C_3 (minimum tillage), and D_3 (no tillage).

Individual plots were 4.9 m wide by 15.0 m long with a grain sorghum row spacing of 76.2 cm. The experimental design was a complete randomized block with five replications. Three complete blocks of treatments were initially set up in 1962 to provide one block for each phase of the rotation each year. This allowed data to be taken each year on all three phases of the rotation.

Grain sorghum stalk rot data.—The incidence of stalk rot was determined by squeezing the base of 100 stalks in

TABLE 1. The effect of ecofallow (reduced tillage) on stalk rot and yield [kg/hectare (ha)] of grain sorghum grown in a winter wheat-grain sorghum-fallow rotation

Year	Tillage treatment	Stalk rot[a] (%)	Yield[a] (kg/ha)
1972[e]	Conventional[b]	45	1570
	Minimum[c]	32	2072
	No tillage[d]	15	2324
1973	Conventional	51	3077
	Minimum	33	5401
	No tillage	14	5275
1974	Conventional	20	3517
	Minimum	5	4270
	No tillage	3	3894
3-yr. avg.	Conventional	39 A[f]	2721 A[f]
	Minimum	23 B	3914 B
	No tillage	11 C	3831 B

[a]Mean of five replications. For the stalk rot data, 100 stalks were examined in each plot. For the yield data, three 12.0 m rows were combine harvested in the middle of each plot.

[b]Conventional tillage–sweep tillage operations as needed to control weeds throughout the rotation period and conventional tillage to prepare seedbed. Sorghum was cultivated as needed and sprayed with 2,4-D ester at 280 gm/ha.

[c]Minimum tillage–Paraquat herbicide after wheat harvest, atrazine in fall, seedbed preparation just prior to planting grain sorghum in spring, atrazine and propachlor preemergence. Tillage as needed to control weeds in fallow period following grain sorghum crop.

[d]No tillage–same as minimum tillage except there is no seedbed preparation and weeds are controlled throughout the fallow period with herbicides.

[e]Yields were suppressed in 1972 due to a severe hail storm on July 25th which caused 100% defoliation of the grain sorghum.

[f]Values not followed by the same letters are significantly different, $P = 0.01$, according to Duncan's multiple range test.

each plot just prior to harvest in 1972, 1973, and 1974. In all three years the grain sorghum was planted in late May and harvested in mid-October. If the stalk could be squeezed between the forefinger and the thumb it was recorded as having stalk rot. Random examinations of individual stalks were made by splitting the stalk lengthwise to insure that those plants being recorded as having stalk rot were actually infected by *Fusarium* spp. as evidenced by a pinkish discoloration of the vascular tissue (5). Fusarium stalk rot caused primarily by *F. moniliforme* Sheldon was the predominant type occurring at the experimental site. Charcoal rot caused by *Macrophomina phaseoli* (Maubl.) Ashby was not observed during the three 3 years of this test (5). Yield data were taken by combine harvesting three 12.0 m rows out of the middle of each plot and adjusting to 14% moisture.

RESULTS.—In each of the 3 years of this study, stalk rot was reduced and grain yield was increased when grain sorghum was grown under either minimum tillage or no tillage practices as compared to conventional tillage (Table 1). The 3-year average showed that the stalk rot incidence was reduced from 39% under conventional tillage to 23% and 11% under minimum tillage and no tillage, respectively. The 3-year average grain yield was 3,912 kg/ha for minimum and 3,831 kg/ha for no tillage as compared to 2,719 kg/ha for conventional tillage. This gives an average decrease in stalk rot of 41% and 72% and an average increase in yield of 44% and 41% with minimum tillage and no tillage, respectively over conventional tillage. These differences were highly significant between the two ecofallow tillage systems and the conventional tillage system.

DISCUSSION.—The dramatic effects of ecofallow on both stalk rot and yield of grain sorghum grown in a winter wheat-grain sorghum-fallow rotation may offer an answer to some of the pest problems (weeds, insects, and diseases) encountered when reduced tillage is practiced (1). The ecofallow system differs from most reduced tillage practices in that one crop is planted directly into the residue of another type of crop rather than into the residue of the same type of crop. The growing of two different types of crops may, then, be a useful mechanism to avoid the pitfalls encountered when monoculturing is practiced under reduced tillage. Monoculturing with reduced tillage may be allowing disease build up due to host susceptibility and pathogen specificity. The use of two different types of crops, then, may be breaking this link in the build up of pests thus keeping them at a tolerable level.

Information on the long-term effects of reduced tillage on pests, especially plant diseases, is very meager. Boosalis and Cook (2) have recently reviewed this subject. The ecofallow rotation system and experimental site area described above would appear to offer a unique situation wherein the long-term effects of reduced tillage on plant diseases and other pests of winter wheat and grain sorghum can be evaluated. The higher yields of grain sorghum obtained when planted directly into wheat stubble with reduced tillage may be due in part to the combined integrated effects of: (i) lower incidence of stalk rot; (ii) increased water conservation; (iii) reduced soil temperature fluctuations; (iv) lower mean soil temperature; and (v) better weed control through the use of herbicides. The lower incidence of stalk rot may be attributed to factors ii through v. Studies are in progress to further delineate the effect of these factors and others upon the incidence of stalk rot and the yield of grain sorghum grown in the winter wheat-grain sorghum-ecofallow (reduced tillage) system described above.

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